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<u>L6</u>	6014670.pn.	2	<u>L6</u>
<u>L5</u>	5978788.pn.	2	<u>L5</u>
<u>L4</u>	"star schema" and (datawarehouse or data with warehouse or datamart or data with mart)	90	<u>L4</u>
<u>L3</u>	"reverse star schema"	7	<u>L3</u>
<u>L2</u>	"reverse star schema".ti.ab.	16	<u>L2</u>
<u>L1</u>	"reverse stare schema".ti.ab.	13	<u>L1</u>

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Search Results - Record(s) 1 through 7 of 7 returned.

☐ 1. Document ID: US 20030115211 A1

L3: Entry 1 of 7

File: PGPB

Jun 19, 2003

PGPUB-DOCUMENT-NUMBER: 20030115211

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030115211 A1

TITLE: Spatial intelligence system and method

PUBLICATION-DATE: June 19, 2003

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Chen, Li-Wen	Cupertino	CA	US	
Luu, Victor	Morgan Hill	CA	US	

US-CL-CURRENT: [707/102](#); [707/104.1](#)

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMIC	Draw. Ds
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☐ 2. Document ID: US 20020116389 A1

L3: Entry 2 of 7

File: PGPB

Aug 22, 2002

PGPUB-DOCUMENT-NUMBER: 20020116389

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20020116389 A1

TITLE: System and method for providing a data warehouse in accordance with a virtual schema

PUBLICATION-DATE: August 22, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Chen, Li-Wen	Cupertino	CA	US	
Ortiz, Juan J.	Hayward	CA	US	

US-CL-CURRENT: [707/103R](#)

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC	Draw. De
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☐ 3. Document ID: US 20020059183 A1

L3: Entry 3 of 7

File: PGPB

May 16, 2002

PGPUB-DOCUMENT-NUMBER: 20020059183  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20020059183 A1

TITLE: Method and system for managing event attributes

PUBLICATION-DATE: May 16, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Chen, Li-Wen	Cupertino	CA	US	

US-CL-CURRENT: 707/1; 705/8, 705/9, 707/104.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC	Draw. De
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☐ 4. Document ID: US 20020038230 A1

L3: Entry 4 of 7

File: PGPB

Mar 28, 2002

PGPUB-DOCUMENT-NUMBER: 20020038230  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20020038230 A1

TITLE: User interface and method for analyzing customer behavior based upon event attributes

PUBLICATION-DATE: March 28, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Chen, Li-Wen	Cupertino	CA	US	

US-CL-CURRENT: 705/7

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC	Draw. De
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☐ 5. Document ID: US 6411961 B1

L3: Entry 5 of 7

File: USPT

Jun 25, 2002

US-PAT-NO: 6411961  
DOCUMENT-IDENTIFIER: US 6411961 B1

TITLE: Apparatus for providing a reverse star schema data model

DATE-ISSUED: June 25, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Chen; Li-Wen	Cupertino	CA		

US-CL-CURRENT: 707/102; 705/10, 707/104.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw. De
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☐ 6. Document ID: US 6377934 B1

L3: Entry 6 of 7

File: USPT

Apr 23, 2002

US-PAT-NO: 6377934

DOCUMENT-IDENTIFIER: US 6377934 B1

TITLE: Method for providing a reverse star schema data model

DATE-ISSUED: April 23, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Chen; Li-Wen	Cupertino	CA		
Ortiz; Juan J.	Hayward	CA		

US-CL-CURRENT: 705/10; 707/102, 707/104.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw. De
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☐ 7. Document ID: US 6363353 B1

L3: Entry 7 of 7

File: USPT

Mar 26, 2002

US-PAT-NO: 6363353

DOCUMENT-IDENTIFIER: US 6363353 B1

TITLE: System for providing a reverse star schema data model

DATE-ISSUED: March 26, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Chen; Li-Wen	Cupertino	CA		

US-CL-CURRENT: 705/10; 707/102, 707/104.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw. De
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"reverse star schema"	7

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<u>L18</u>	L7 and (rolap or metacube same data near warehouse)	55	<u>L18</u>
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<u>L11</u>	6004276.pn.	1	<u>L11</u>
<u>L10</u>	6325540.pn.	1	<u>L10</u>
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<u>L4</u>	L1 and (data with warehouse or data with mart)	0	<u>L4</u>
<u>L3</u>	L1 and data with warehouse or data with mart	272	<u>L3</u>
<u>L2</u>	L1 and (datawarehouse or data with warehouse or datamart or data with mart)	0	<u>L2</u>
<u>L1</u>	5822744.pn.	2	<u>L1</u>

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Search Results for: [rolap &lt;and&gt; aggregate &lt;and&gt; views]

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[> Advanced Search](#)[> Search Help/Tips](#)Sort by: [Title](#) [Publication](#) [Publication Date](#) [Score](#) [Binder](#)Results 41 - 47 of 47 [short listing](#)[1](#) [2](#) [3](#)**41** [Requirement-based data cube schema design](#)

77%

David W. Cheung , Bo Zhou , Ben Kao , Hongjun Lu , Tak Wah Lam , Hing Fung Ting  
**Proceedings of the eighth international conference on Information and knowledge management** November 1999

On-line analytical processing (OLAP) requires efficient processing of complex decision support queries over very large databases. It is well accepted that pre-computed data cubes can help reduce the response time of such queries dramatically. A very important design issue of an efficient OLAP system is therefore the choice of the right data cubes to materialize. We call this problem the data cube schema design problem. In this paper we show that the problem of finding an op ...

**42** [Compressed data cubes for OLAP aggregate query approximation on continuous dimensions](#)

77%

Jayavel Shanmugasundaram , Usama Fayyad , P. S. Bradley  
**Proceedings of the fifth ACM SIGKDD international conference on Knowledge discovery and data mining** August 1999

**43** [Simultaneous optimization and evaluation of multiple dimensional queries](#)

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Yihong Zhao , Prasad M. Deshpande , Jeffrey F. Naughton , Amit Shukla  
**ACM SIGMOD Record , Proceedings of the 1998 ACM SIGMOD international conference on Management of data** June 1998

Volume 27 Issue 2


Database researchers have made significant progress on several research issues related to multidimensional data analysis, including the development of fast cubing algorithms, efficient schemes for creating and maintaining precomputed group-bys, and the design of efficient storage structures for multidimensional data. However, to date there has been little or no work on multidimensional query optimization. Recently, Microsoft has proposed &ldquo;OLE DB



for OLAP&rdquo; as a standard multidime ...

**44** Dynamic assembly of views in data cubes


77%

 John R. Smith , Vittorio Castelli , Anant Jhingran , Chung-Sheng Li

**Proceedings of the seventeenth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems** May 1998

**45** The IBM data warehouse architecture


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 Charles Bontempo , George Zagelow

**Communications of the ACM** September 1998  
Volume 41 Issue 9

**46** Quasi-cubes: exploiting approximations in multidimensional databases

77%


 Daniel Barbará , Mark Sullivan

**ACM SIGMOD Record** September 1997  
Volume 26 Issue 3

A data cube is a popular organization for summary data. A cube is simply a multidimensional structure that contains at each point an aggregate value, i.e., the result of applying an aggregate function to an underlying relation. In practical situations, cubes can require a large amount of storage. The typical approach to reducing storage cost is to materialize parts of the cube on demand. Unfortunately, this lazy evaluation can be a time-consuming operation. In this paper, we desc ...

**47** Data warehousing and OLAP for decision support

77%



 Surajit Chaudhuri , Umeshwar Dayal

**ACM SIGMOD Record , Proceedings of the 1997 ACM SIGMOD international conference on Management of data** June 1997  
Volume 26 Issue 2

On-Line Analytical Processing (OLAP) and Data Warehousing are decision support technologies. Their goal is to enable enterprises to gain competitive advantage by exploiting the ever-growing amount of data that is collected and stored in corporate databases and files for better and faster decision making. Over the past few years, these technologies have experienced explosive growth, both in the number of products and services offered, and in the extent of coverage in the tra ...

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L18: Entry 32 of 55

File: USPT

Apr 15, 2003

DOCUMENT-IDENTIFIER: US 6549907 B1

TITLE: Multi-dimensional database and data cube compression for aggregate query support on numeric dimensions

Brief Summary Text (9):

As data warehousing becomes more popular, OLAP is gaining in importance as a primary interface to evaluating data contained in the data warehouse. Most successful data mining applications include reporting systems having fast query response mechanisms. Most corporations require decision support and would benefit from improved technology to help in making decisions based upon rapidly gathered and organized data.

Other Reference Publication (33):

Y. Kotidis, N. Rousopoulos, "An Alternative Storage Organization for ROLAP Aggregate Views Based On Cubetrees", Proc., ACM SIGMOD Conf., Seattle, 1998.

Other Reference Publication (34):

I. Mumick et al., "Maintainance of Data Cubes and Summary Tables in a Warehouse", Proc. ACM SIGMOD Conf., Tuscon, 1997.

# Data Warehousing and OLAP for Decision Support

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## Description

On-Line Analytical Processing (OLAP) and Data Warehousing are *decision support* technologies. Their goal is to enable enterprises to gain competitive advantage by exploiting the ever-growing amount of data that is collected and stored in corporate databases and files for better and faster decision making. Over the past few years, these technologies have experienced explosive growth, both in the number of products and services offered, and in the extent of coverage in the trade press. Vendors, including all database companies, are paying increasing attention to all aspects of decision support.

Decision support places some rather different requirements on database technology as compared to traditional on-line transaction processing (OLTP) applications. OLTP applications typically automate clerical data processing tasks such as order entry and banking transactions that are the bread-and-butter, day-to-day operations of an organization. These tasks are structured and repetitive, and consist of short, atomic, isolated transactions, which require detailed, up-to-date data, and read or update a few (tens of) records. Consistency and recoverability of the database are critical, and maximizing transaction throughput is the key performance metric.

Decision support, in contrast, requires historical, summarized and consolidated data from many sources scattered through the enterprise. Data is extracted from these sources and loaded into a data warehouse, a large, integrated, relatively static, database that is often maintained separately from the organization's operational databases. To facilitate complex analyses and visualization, the data warehouse typically supports a *multidimensional* model of data. Since data warehouses contain consolidated data, perhaps from several operational databases, over potentially long periods of time, they tend to be orders of magnitude larger than operational databases; enterprise data warehouses are projected to be hundreds of gigabytes to terabytes in size. The workloads are query intensive with mostly *ad hoc*, complex queries that can access millions of records. Query throughput and response times are more important than transaction throughput.

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Data warehouses might be implemented on standard or extended relational database management systems, called *Relational OLAP (ROLAP)* servers. These servers assume that data is stored in relational databases, using special database designs (star and snowflake schemas) to represent the multidimensional data model; special access methods and query processing techniques to efficiently map OLAP operations on the underlying relational database. Alternatively, *multidimensional OLAP (MOLAP)* servers may be used. These are specialized servers that directly store multidimensional data in special data structures (e.g., arrays) and implement the OLAP operations over these special data structures.

This tutorial provides a roadmap of data warehousing and OLAP technologies, with an emphasis on their new requirements. We describe back end tools for extracting, cleaning and loading data into a data warehouse; multidimensional data models and OLAP operations; front end client tools for querying and data analysis; server extensions for efficient query processing; and tools for metadata management and for managing the warehouse. We survey the state of the art and mention representative products. In a recent overview paper, we have summarized the issues that are discussed in this tutorial [1].

The area opens up interesting research directions, with ties to past work in database systems, but with different assumptions and requirements. Only very recently, however, has the database research community started to address some of these issues. Research in data warehousing so far has focused primarily on query processing and view maintenance issues. There still are many open research problems. We describe some of these briefly.

## Outline

1. Introduction
  - definitions, evolution, differences from OLTP, architectures
2. Models and Tools
  - conceptual model for OLAP
  - front-end tools (e.g., multidimensional spreadsheets)
  - database design (e.g., star and snowflake schema)
3. Database Server technologies for Decision Support Queries
  - specialized indexing and query processing techniques

- intelligent processing of aggregates
  - complex query processing
  - extensions to SQL
  - ROLAP vs MOLAP
4. Other Services for OLAP/Data warehousing
    - data cleaning, loading and refresh
    - tools for warehouse, system and process management
    - metadata management and the role of repository
  5. State of Commercial Practice
  6. Research Issues

#### **References**

- [1] S. Chaudhuri, and U. Dayal, "An Overview of Data Warehousing and OLAP Technology", SIGMOD Record, March 1997.

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1997, Tucson, Arizona, United States

Data warehousing and OLAP for decision support

[> Also published in ...](#)**Authors**[Surajit Chaudhuri](#)[Umeshwar Dayal](#)**Sponsor**[SIGMOD](#) : ACM Special Interest Group on Management of Data**Publisher**

ACM Press New York, NY, USA

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[doi> http://doi.acm.org/10.1145/253260.253373](http://doi.acm.org/10.1145/253260.253373) (Use this link to Bookmark this page)[> full text](#) [> abstract](#) [> references](#) [> citings](#) [> index terms](#) [> peer to peer](#)[> Discuss](#)[> Similar](#)[> Review this Article](#)[Save to Binder](#)[> BibTex Format](#)[↑ FULL TEXT:](#) [Access Rules](#)[pdf 223 KB](#)[↑ ABSTRACT](#)

On-Line Analytical Processing (OLAP) and Data Warehousing are decision support technologies. Their goal is to enable enterprises to gain competitive advantage by exploiting the ever-growing amount of data that is collected and stored in corporate databases and files for better and faster decision making. Over the past few years, these technologies have experienced explosive growth, both in the number of products and services offered, and in the extent of coverage in the trade press. Vendors, including all

database companies, are paying increasing attention to all aspects of decision support.

## ↑ REFERENCES

Note: OCR errors may be found in this Reference List extracted from the full text article. ACM has opted to expose the complete List rather than only correct and linked references.

1 Surajit Chaudhuri , Umeshwar Dayal, An overview of data warehousing and OLAP technology, ACM SIGMOD Record, v.26 n.1, p.65-74, March 1997

## ↑ CITINGS 2

Lixin Fu , Joachim Hammer, CubiST: a new algorithm for improving the performance of ad-hoc OLAP queries, Proceedings of the third ACM international workshop on Data warehousing and OLAP, p.72-79, November 06-11, 2000, McLean, Virginia, United States

Stefan Berchtold , Christian Böhm , Hans-Peter Kriegel, The pyramid-technique: towards breaking the curse of dimensionality, ACM SIGMOD Record, v.27 n.2, p.142-153, June 1998

## ↑ INDEX TERMS

Primary Classification:

H. Information Systems

↳ H.4 INFORMATION SYSTEMS APPLICATIONS

↳ H.4.2 Types of Systems

↳ **Subjects:** Decision support (e.g., MIS)

Additional Classification:

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Design, Management, Performance, Theory

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